

# Evaluating the Impacts of Nanotechnology via Thermodynamic and Life Cycle Analysis

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U.S. EPA 2005 Nanotechnology Science to Achieve Results (STAR)  
Progress Review Workshop - Nanotechnology and the Environment III  
Washington, DC, October 26 - 28, 2005



# Objectives

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- ▣ Develop new
  - data,
  - tools and
  - techniquesfor evaluating the
  - life cycle environmental and
  - economic aspects of nanomanufacturingto encourage sensible engineering decisions and policy
- ▣ Specific goals
  - Develop life cycle inventory data of nanomanufacturing
  - Perform LCA of nano and traditional processes and products
  - Account for uncertainties
  - Perform Thermodynamic LCA and test hypotheses for evaluating life cycle impact with limited information

# Methods

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- Obtain nanomanufacturing data via experimentation and from collaborators
  - Synthesis of nanoclays and carbon nanofibres
  - Preparation of polymer nanocomposite
  - Manufacturing of selected nanoproduct
- Obtain latest fate, transport, and impact information of emissions from literature and collaborators
- Life Cycle Analysis of nanomanufacturing
  - Combine data from laboratory, LCA databases, economic models, etc. via multiscale LCA
  - Use data for Thermodynamic LCA
- Account for uncertainties
- Test thermodynamics-based hypotheses for evaluating life cycle impact of emerging technologies

# Time Frame

Objectives	Year 1	Year 2	Year 3
1) Nanomanufacturing Modules			
2) Traditional LCA of consumable and durable nanoproducts and alternatives			
3) Exergy analysis of nanomanufacturing modules			
4) Thermodynamic LCA of Nanomanufacturing			
5) Case studies for testing proposed hypotheses			
6) Tool for LCA and economic analysis of polymer nanocomposites			

# Relation to Protecting the Environment and Human Health

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- Identifying and managing risk in research, development and commercialization of nanomanufacturing
- Preventing irrational optimism or unfounded fear about nanotechnology
- Balancing harm to the environment and human health with economic feasibility
- Developing techniques for gaining insight into the life cycle impact of emerging technologies
- Implementing a tool for LCA and economic analysis of polymer nanocomposites